

Refereed papers

Designing and implementing an electronic health record system in primary care practice in sub-Saharan Africa: a case study from Cameroon

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ABSTRACT

Objective To review the key issues related to the design and implementation of an electronic health record (EHR) system in urban primary health care (PHC) practice in Cameroon.

Methodology The goal of the project was to assess EHR as a tool to improve providers' performance, quality and continuity of care, and the availability of data in PHC practice in Cameroon. A locally designed EHR system called MEDCAB was developed. The system was based on the International Classification for Primary Care (ICPC) and was designed taking into consideration the PHC practice environment in Cameroon. An original cohort of 14 users was involved in the experiment.

Results Users generally showed good acceptance of the system. Monitoring the use of the system at the early stages of implementation was important to ensure immediate response to users' comments and requests. Some of the key issues identified during the development and implementation of the system

were: user involvement, the choice of an appropriate terminology, pre-existing data collection culture and leadership issues. Some positive achievements brought about by the system included promotion of good medical practice and routine availability of consultation data.

Conclusion Strengthening the medical record in general, and the EHR in particular, could contribute to its position as a valuable source of information for healthcare delivery, public health and policy making in Cameroon. Challenges to adoption are huge and successful implementation for any specific setting will require a comprehensive modelling of the local medical practice, the choice of an appropriate terminology and a co-ordinated approach involving all stakeholders.

Keywords: Cameroon, computerised medical record, International Classification for Primary Care, primary health care

Introduction

In Cameroon, as in most developing countries of sub-Saharan Africa, availability of data of good quality for decision making remains a big challenge. The reason for encounter (RFE) represents the agreed statement

of the reasons why a patient enters the healthcare system.¹ The RFE is the basis of the problem-oriented approach predominantly used in developing countries, where, due to work overload, differing training

background of practitioners and limited resources, a definitive diagnosis can be difficult to arrive at. Therefore, routine consultation can provide useful information to assess quality and continuity of care, to identify gaps for provider education and to allocate scarce resources. Unfortunately, data generated during the routine provider–patient encounter (PPE) are given limited attention. The disease surveillance ‘data pipe’ is fuelled by major public health programmes, consisting of multiple parallel or integrated interventions, targeting specific conditions and addressing specific public health emergencies such as HIV/AIDS, malaria, tuberculosis and child immunisation.

Several ambiguous acronyms and definitions have been provided for the computerised health record, here referred to as EHR (electronic health record).^{2–4} The EHR is here defined simply as an amalgam of data acquired and created during a patient’s course through the health care system and stored in an electronic medium.⁵ Active research is being conducted in developed countries on the design, implementation, acceptability and sustainability of the EHR. However, very few studies have dealt with the topic in the developing countries of sub-Saharan Africa.^{6,7} This paper reviews the process of the design and pilot implementation of MEDCAB, a locally designed EHR system for primary care in Cameroon. Special emphasis will be laid on technical aspects, selection of an appropriate terminology, key factors for successful implementation, potential benefits and challenges for sustainability.

Medical encounter and the health record in Cameroon

The principal provider of health care in Cameroon is the public sector. The health district represents the operational unit of health policy and the health centre is the first point of contact with the health system. As in most places in sub-Saharan Africa, the public health landscape of Cameroon reflects that of a country in epidemiological transition. HIV/AIDS, tuberculosis and malaria are important causes of mortality and morbidity, while the burden attributable to vaccine-preventable diseases of childhood remains heavy despite significant progress in measles control.^{8,9} The prevalence of non-communicable conditions like hypertension is reaching epidemic proportions, and figures as high as 18% have been reported in urban areas.^{10–12}

In Cameroon, the concept of the health record is embryonic and sometimes limited to big urban hospitals. Existing data collection tools usually consist of non-standardised and incomplete paper-based registers showing considerable variation across facilities, providers and time. This lack of standardisation does not

allow the use of the recorded information for research or policy making. Several explanations have been attempted to explain the low interest of health providers, policy makers and patients in the patient record in Cameroon: limited institutional framework and political commitment; work overload; insufficient training; low motivation; intensive medical shopping with a patient consulting more than one provider for a single episode of care; and a culture unfavourable to data collection from both patients and providers.¹³ Implementing an EHR in such a context appeared therefore to be a great challenge.

Objective

The overall goal of the project was to experiment with the use of an EHR in primary health care (PHC) as a means to improve providers’ performance, quality and continuity of care, and to increase the availability of routine outpatients’ consultation data. This paper reviews the key issues related to the design and implementation of an EHR system in urban PHC practice in Cameroon.

Methods

System design

Modelling the provider–patient encounter

In-depth modelling of PPE in urban primary care settings was conducted using interviews and direct observation. Some of the main findings, even though probably not applicable to all primary care settings in the country, are summarised in Box 1.

Box 1 Some key aspects of primary care in Cameroon

- High volume of consultation (number of patients consulted by each provider per day)
- High diversity of providers’ training background (doctors, nurses)
- High burden of infectious diseases
- Limited amount of information collected
- Non-standardisation of existing data collection tools
- Low availability of diagnosis technical support and laboratory
- Patient-intense medical shopping behaviour
- Out-of-pocket services (no social security)

Figure 1 shows a typical patient flow in a common high-activity urban primary health care centre in Cameroon. This flow diagram demonstrates the complex relationship existing between the different flow entities: triage, consultation, laboratory and pharmacy. Opportunities to collect complete and therefore useful information on disease are limited since chances for the patient actually to undergo a formal medical contact vary.

Most patients will escape the normal triage–consultation and/or lab and/or pharmacy, or will do so incompletely since each one of these steps may add an additional amount of money to the total cost of the visit. To minimise the cost of the visit and the workload, services are sometimes provided in the different entities independently from the others (e.g. the patient comes just to buy medicine or for a specific procedure). Patients will seek medical advice only when the condition gets beyond their capacity of resolution and starts to interfere noticeably with their daily activities. These last aspects suggest that, even though information collected over PPE does not reflect the overall level of utilisation of health services, it may provide useful information on the morbidity of a condition in the population. This model reveals the uniqueness of the PPE in Cameroon as compared to the developed world and hints at the possibility for high risk of failure when any imported model and systems are used in this context.

Selection of appropriate terminology

In PHC, providers plan their operational approach to address the demands for care expressed by the patient. Disease classifications are designed to allow the health provider's interpretation of a patient's health problem to be coded in the form of an illness, disease or injury.

In Cameroon and probably in similar settings in Africa, data on disease reporting (when they exist) tend to be clinically (as opposed to diagnostically) based. A classification for primary care must fulfil specific requirements, differing from those in other branches of medicine because of the difference in conditions seen and diagnostic and management processes involved.¹ The selection of an appropriate classification for the system was based on appropriateness for primary care, simplicity and availability in English and French (the two official languages of Cameroon). Several classifications were evaluated from the literature and by mapping reasons for encounter and diagnoses from several PHC consultation registers. The International Classification for Primary Care (ICPC-2) appeared to be the most appropriate choice. Official authorisation was sought from WONCA to use ICPC-2 in the system.^{14–16}

RFE as recorded by ICPC focuses on the patient's perception of their health problem and represents the agreed statement of the reason(s) why the patient enters the healthcare system. In this sense, ICPC is patient-oriented rather than disease-oriented; it allows healthcare providers to keep track of the demand for care.¹ This last aspect of ICPC sounds critical in an environment where the final diagnosis is often not reached; the aim is not to come up with the exact diagnosis or aetiological factor underlying the condition, but to provide quick relief at a minimum cost. The ICPC-2 Extended Terminology LOCAS (Logiciel de Codage et d'Acquisition des Synonymes) was chosen as the final terminology for the system.¹⁷ LOCAS increases the granularity of ICPC by adding a three-digit unique identifier to each standard ICPC-2 code, allowing the coding and storage of more specific terms (see Table 1).

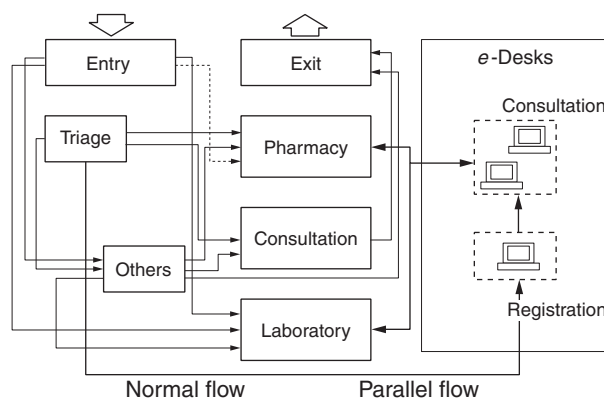


Figure 1 The patient flow in a typical high-activity primary care facility. The normal flow (light arrows) represents normal activity. The new parallel flow (thin arrows) was created to avoid interference with ongoing activities. Depending on the workload at the electronic registration desk, new patients are accepted or not from the normal flow (triage). e-Desk: electronic registration and consultation desks

Table 1 Example showing the six-digit coding of LOCAS* based on a standard ICPC-2 term

Standard ICPC term	Standard ICPC-2 code	LOCAS* term	LOCAS code
Animal bite	S13	Animal bite, not classified elsewhere	S13.001
		Human bite	S13.002
		Dog bite	S13.003
		Cat bite	S13.004

* LOCAS: Logiciel de Codage et d'Acquisition des Synonymes

Technical considerations

A new EHR called MEDCAB was released at the beginning of 2003. Microsoft Windows was used as the platform for system development. Visual Basic 6 (VB) was selected as the programming language, based on the availability of highly skilled VB programmers in the research team. Microsoft Access was selected as the system's database. The format for a stand-alone application was given priority because of

the low computer penetration in the country.¹⁸ A network version using MySQL as the database management system was available for multi-user settings. The application development process was conducted with interactions and inputs from end users acting as testers. In the context of the experiment, a patient-provider contact was defined as a single encounter of a patient with a provider. The system was designed to keep track of each contact.

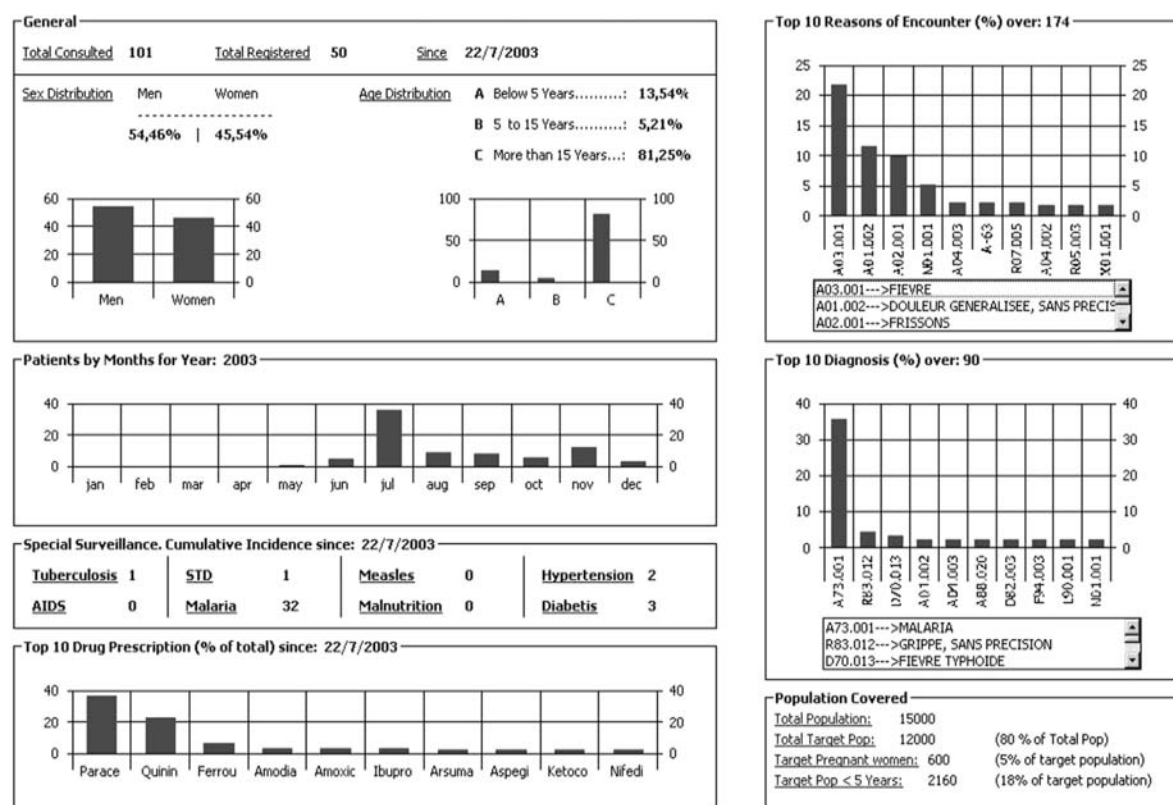


Figure 2 A snapshot of the MEDCAB control station, featuring basic descriptive statistics of consultation activities

Description and functionalities of the system

To allow easy handling by qualified as well as low-skill health professionals, simplicity, intuitiveness and stability were the key concepts used in system development. The system consists of several user interfaces with multiple functionalities including: users' administration, medical encounter, patient registration, statistics (see Figure 2), appointment management, report generator, patient card generator, etc. For each patient, the summary of a specific visit (see Figure 3) or the entire medical history can be generated as a text or html file. The main encounter data entry screen was designed to limit changes in the consultation practices of the provider by, for example, keeping the amount of new information to be collected to a strict minimum.

VISIT REPORT / PROVIDER...: A408 / SETTING: 000
Generated on the: 15 / 10 / 2004

Parameters

Weight: 67Kg Height: Na Cm BMI: Na Kg/m2
BP: 130/78 mmHg Pulse: 80 b/mm
Temperature: 40 °C

Raison(s) of the Encounter - Motif(s) de Consultation

A03.001 Since: 3 Jours
A01.002 Since: 3 Jours
N01.001 Since: 3 Jours

Summary of Physical Exam / Résumé de l'Examen Physique

EP normal sauf fièvre

Diagnosis

A73.001

Comments / Commentaires

faire examen labo

Paraclinical Exams

Numeration NFS: Not reported
Taux Hemoglobine Hb: 12g/l
GP ABO Rhésus: A Rhésus Positif
GE: Trophozoites de PF +++
SELLES(KOAP): Oeufs d'ascaris

Prescription

Paracetamol Tab 500 mg: 2 op x 3/jrs si douleur max 6 par jrs
Arsumax NS: 2-0-2 a J1
Arsumax NS: 1-0-1 de J2 a J5

Figure 3 A sample visit report generated by MEDCAB. Identifiable information has been hidden to protect patient privacy. ICPC-2 (Extended Terminology LOCAS) codes in RFE and diagnosis are circled. The figure also shows the basic information collected during a typical primary care encounter in Cameroon (telegraphic style)

Coding with ICPC-2 in MEDCAB

The system allows the recording of not more than three RFE and diagnoses per contact. ICPC-2 (Extended Terminology LOCAS) is used for directly

coding RFE and diagnosis using the concept of terming: a term is positioned in the pick list based on the acronym or brief key term entered by the user (see Figure 4). The system checks for duplicate entries for both RFE and diagnosis and stores the code of the selected term in the system database.

REASON(S) OF THE ENCOUNTER, TEXT AND ICPC-2 CODE AND DURATION

Digestif	Code
1- FIE	
2- FIEVRE	
FIEVRE APTEUSE	
3- FIEVRE JAUNE	
FIEVRE PARATYPHOIDE	
SUN FIEVRE TYPHOIDE	

Figure 4 Coding RFE and diagnosis with ICPC in MEDCAB using the concept of terming: a term is positioned in the pick list based on the acronym or brief key term entered by the user

System implementation

Regular users were doctors and primary care nurses, selected based on their willingness to participate and the availability of a computer. They were identified in a cascade manner (an identified user bringing the next one whom he knew may be interested). An original cohort of 14 providers (ten medical doctors and four nurses, 11 from the public sector and three from the private) attended the initial training. Users were self-selected, based on their personal interest in medical and health data, to consolidate a micro-epidemiologic database of their medical practice. The typical profile of our users was young age, previous usage of computers and interest in research activities.

The network version was tested under the request of the management officials in a private urban health centre on three computers (one registration and two consultation desk). Involvement of the management staff, availability of computers, and existence of a prior and strong data collection culture were all important prerequisites for site selection. Numerous meetings, involving users and the different stakeholders at the centre (nurses, administrative staff, and pharmacy and data clerks), were held, the objective being the adoption of a comprehensive implementation strategy. A three-day training session was organised to familiarise the prospective users with ICPC-2, basic computer usage, good data management practice (folder structure and back-up principles) and usage of the system. The initial testing started in June 2003. To avoid interfering with ongoing activities and creating frustration and rejection by the end-users, a new data flow was added in parallel to the existing one (see Figure 1). Because an initial increase in the duration of the consultation was expected with the introduction of the EHR, patients coming from triage were directed into the parallel flow in a co-ordinated manner, paced

by the progression of the waiting queue. In periods of high congestion, providers were allowed to record encounter information on forms reflecting the data entry screen of the system. That information was entered into the system later with the help of a supervisor and provided additional opportunities for training.

Observations

Subjectivist approaches to evaluation of information systems were used to measure the response of our users. Several data collection strategies have been identified using subjectivist approaches, but we focus mostly on direct observations and interviews.¹⁹ On a regular basis, one of the investigators was immersed in the setting, acting as an unobtrusive observer. The behaviour of users and patients, including interactions between users, patients and the system, was noted. Feedback from users was recorded on a permanent basis by our observer. To assess users' perception at different stages of the implementation process, formal interviews were conducted using a standard interview protocol after one and five months of usage. Areas of investigation included: data entry screens (simple or complicated to use); stability (unexpected behaviour); benefits to the patient; benefits to the user; possible areas of improvement and weaknesses. These areas were adapted from the dimensions of success compiled by van der Meidjen *et al* in their review of determinants of success in inpatient clinical information systems.²⁰ Users generally showed good acceptance of the system, measured by the comments expressed.

Although minor technical issues were identified, the system worked as intended. Monitoring the use of the system at the early stages of implementation appeared to be necessary to ensure immediate response to users' comments and requests. A transfer of provider's interest from the patient to the computer, together with an increase in the duration of contact, was noted, resulting in significant increase in workload. From the fourth month of regular use, a decrease in coding time with a corresponding reduction of the duration of consultation and better management of patient flow was achieved. Another positive achievement included promotion of best practice; this was done through the system prompting for measurement of parameters and checking for unusual values (temperature, blood pressure, weight, etc.), reminders for conditions requiring special attention (chronic diseases, allergy, pregnancy, etc.) and making data from previous contacts readily available. The easy generation of activity reports and statistics increased the data quality of routine consultation. An unexpected finding was an increase in users' self-esteem and positive image of the facility

in the community. Requests for improvement of the system were made by users. Some requested enhancements included: a data entry module for detailed pregnancy examination; separate modules for HIV/AIDS and tuberculosis; a separate vaccine registry to track individual routine immunisation status of children living in the health facility catchment area; billing and stock management. Though technically easy to incorporate, each of the requested changes was revisited with users during an assessment meeting, and common concerns were given priority.

The challenge of adoption and sustainability

The original cohort of MEDCAB users were self-selected based on their personal interest in medical and health data to consolidate their medical practice. This highly self-selected group raised the issue of adoption by other users with different interests. After 14 months of usage, eight providers were still using the system (dropout rate 50%). The main reasons for dropout included changes in personnel (with trained personnel leaving the practice or the facility); changes in the management staff of the facility with the new management giving lower attention to the project; loss of computer (continual hardware breakdown) and departure of most of the main investigators.

Discussion

This project is probably the first documented attempt to implement, in the primary care context of Cameroon, a comprehensive EHR based on ICPC. This experiment, carried out without external support, demonstrates the existence of some opportunities for EHR research for primary care in sub-Saharan Africa. The users, self-selected based on their interest in research and computers, expressed good acceptance of the system. However, the highly selected group of initial users can be considered a limitation in the study as it raised some concerns about the generalisability of our findings to a wider group. Barriers to the proliferation of EHR have been widely investigated in developed countries, among which the costs of implementation and fragmentation caused by the use of numerous unique systems have been mentioned.²¹ In addition, the use of computers can be seen as interrupting the physician-patient relationship by drawing the attention of the provider away from the patient towards the machine.

It appears from our experiment that several challenges will have to be addressed by system developers in the initiative of bringing the EHR into primary care practice; among these the lack of a viable paper-based system for routine consultation is probably the most important. In fact, the existence of a well-functioning paper-based system is a prerequisite for the adoption of electronic solutions. However, the EHR, although a potentially powerful tool for disease surveillance, will receive limited attention from funders and policy makers because it does not fit the actual public health agenda. Some aspects that were critical for the users to continue using the system were simplicity, early involvement, and promotion of good medical practice. Absence of a favourable data collection culture among providers and patients, insufficient training, leadership issues, limited computers and resources, high turnover of personnel and high competition of primary care data with actual public health emergencies may be pointed out as potential barriers to the adoption of the EHR in primary care practice in Cameroon. A challenge to sustainability would be better addressed if systems were designed to fit the medical environment, and if end-user involvement and capacity building were carried out at the early stages of systems' development.

Conclusion

Challenges to the implementation of the EHR in primary care practice in Cameroon are huge and may seem outside the priority agenda in this era of public health emergencies. However, the information generated during routine medical consultation and its capture in the EHR could provide valuable information of public health interest. As elsewhere, challenges to adoption are great, but a successful implementation for a specific setting will require comprehensive modelling of the local medical practice and a co-ordinated approach, involving all stakeholders.

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CONFLICTS OF INTEREST

None.

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